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NATIONAL AERONAUTICS **NASA/KSC-27 15 00.23 98 (October 2007)**
AND SPACE ADMINISTRATION **-------------------------------------**
Preparing Activity: KSC **Superseding**
NASA/KSC-27 15 00.23 98 (April 2006)

NASA/KSC GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009
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DIVISION 27 - COMMUNICATIONS

SECTION 27 15 00.23 98

AUDIO-VIDEO COMMUNICATIONS HORIZONTAL CABLING

10/07

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SECTION 27 15 00.23 98

AUDIO-VIDEO COMMUNICATIONS HORIZONTAL CABLING
10/07

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NOTE: This specification covers the requirements for audio pair telephone cable to be installed. Associated components for this system must include splice connectors and splice cases.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.
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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text are automatically

deleted from this section of the project specification when you choose to reconcile references in the publish print process.
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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. AIR FORCE (USAF)

TO 31W3-10-12	(1986) AF Communications Service Standard Installation Practices, Outside Plant Cable Placement
TO 31W3-10-13	(1980; CHG 5 1986) AF Communications Service Standard Installation Practices, Outside Plant Cable Splicing
TO 31W3-10-15	(1980; CHG 3 1982) Outside Plant Cable Testing

U.S. DEPARTMENT OF AGRICULTURE (USDA)

REA PE-89	(1985) Filled Telephone Cable with Expanded Insulation

1.2 GENERAL REQUIREMENTS

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NOTE: If Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS are not included in the project specification, insert applicable requirements therefrom and delete the following paragraph.
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Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to work specified in this section.

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Keep submittals to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, use a code of up to three characters within the submittal tags following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data for the following items. Data must include a complete list of parts, special tools, and supplies with current unit prices and source of supply.

Lubricant
Cable
Splice Connectors
Splice Cases
Connector Blocks
Protection Modules
Terminal Blocks
Spares, Tools, and Equipment

SD-06 Test Reports

Submit test reports for the following tests in accordance with the paragraph entitled, "Testing Audio Cable," of this section. A test plan that includes detailed step-by-step procedures for the cable field test required by this specification and the calibration details for test instruments must be submitted for approval a minimum of 30 days prior to any cable testing.

Insulation Resistance Tests
Section Tests
Loop Resistance Tests

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following items in accordance with paragraph entitled, "Operation and Maintenance," of this section.

Splice Connectors
Central Office Connector
Protection Modules

1.4 AUDIO CABLE IDENTIFICATION

The first two lines on the ID symbol employee the following four characters:

First Character - must denote the number of hundred pair groups of audio pairs in the cable.

Second Character - must be a dash.

Third and Fourth Characters - must denote the gauge of the audio wire.

The second line of the cable ID symbol indicates the conductors are audio type cable, number and pair count.

Example:	6-22	Identifies a 600 pair 22 gage audio
cable	CA 12:1400-2000	2 millimeter diameter (No. 12) No. 12 with pair count 1401-2000.

PART 2 PRODUCTS

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NOTE: Designer must provide under this section a complete list of cable and connector types, including application specifications, that are used on the job and a complete list of cable and harness assembly fabrication drawings and procedures if applicable.
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2.1 TRAINING

Provide a training course at KSC. Course must consist of, but not be limited to, training in splicing, connectorization, and testing.

2.2 CABLE

All Audio Cable must be [REA PE-89] [_____] type Filled Cable.

2.3 SPLICE CONNECTORS

Accomplish splicing utilizing individual compression connectors [AMP Picabond No. 60947-3] [strip assembly No. 60954-4] [_____] or equal in accordance with TO 31W3-10-13, Section 3. Clear and cap all unspliced pairs using [Scotchlock Brand UCC connectors] [_____] or equal.

Central office connector must meet referenced standards within this section.

2.4 SPLICE CASES

Splice cases must be of the [Preformed Line Products] [_____] reenterable stainless steel type, or equal with filling holes. Case size depends on cable size. Splice case must be suitable for reentry without damage to the cable or splice. After completing the splice, totally fill all cases with a reenterable encapsulating compound; [3M's Gella 4441] [_____] or equal.

2.5 CONNECTOR BLOCKS

Connector blocks must be [Reliable Electric's Part No. R39922A 40D] [_____] or approved equal.

2.6 PROTECTION MODULES

Protection modules must be [Reliable Electric's Part No. 6A 20] [_____] or approved equal.

2.7 TERMINAL BLOCKS

Terminal blocks must be [8 by 26] [_____] blocks manufactured by [Reliable Electric] [_____] or approved equal.

2.8 SPARES, TOOLS, AND EQUIPMENT

One continuous length of the longest ordered/manufactured amount of each size of audio cable must be placed on a standard reel and turned over to the Contracting Officer.

One complete set and all furnished manufacturer's data on all tools, equipment and miscellaneous materials of unusual nature or peculiar to this cable installation other than test equipment must be furnished to the Contracting Officer.

PART 3 EXECUTION

3.1 PERSONNEL QUALIFICATIONS

Cable construction work must be performed by construction personnel who have had at least 3 years experience in placing cables in conduit, cable trays, and underground duct systems.

Audio cable splices must be made by journeymen cable splicers who have had a minimum of 5 years experience in splicing and terminating communication cables.

Each individual who is to perform cable splicing is required to perform a minimum of one acceptable sample splice of each type of cable to be spliced. Each individual is required to demonstrate fundamental knowledge of cabling in manholes, ducts and cable racks and demonstrate fundamental knowledge of support and arrangement of cables. Sample splices must not be incorporated in the job.

Give a school of instruction in the presence of the Contracting Officer, or his designated representative, to all individuals who are to perform cable construction and splicing work on this job. This school must consist of a careful and detailed review of construction techniques and splicing work according to the various procedures specified for use on this job. This school must consist of a minimum of 4 hours of instruction. Instructors of this school must be well qualified and must have had a minimum of 5 years experience in the installation and splicing of the type of cable on which they are performing the instruction. A complete instruction course outline plus the certification of the qualifications of the instructors must be submitted to the Contracting Officer for approval no later than 30 days prior to the time that the school of instruction is to begin.

3.2 WORK IN MANHOLES AND CABLE VAULTS

Ensure that safe operating procedures are followed, work equipment is adequate, and personnel have received proper training. All atmospheric tests must be conducted by others prior to Contractor personnel entering a manhole or vault. Safety equipment will be inspected and approved by an authorized representative of the Contracting Officer.

Smoking is not permitted in or around open manholes.

Protect open manholes by fences, railings, signs, flags, or lights, as applicable. Body static electricity that has accumulated must be discharged to ground prior to personnel contact with manhole covers. Removal of manhole covers must be performed by two men using hooks and employing proper lifting techniques. Remove all manhole covers in the immediate vicinity of the duct system where work is to be performed to permit adequate ventilation.

Obtain a burn permit authorizing the use of torches, furnaces, or other open flame, heat-generating devices prior to use of such devices (use is not permitted in manholes).

Each time work is begun, remove or pump excessive water from the manhole vault or duct run, as required, prior to personnel entrance.

A manhole entry permit is required for every manhole entry. This permit will be issued by Environmental Health.

Perform vapor tests to ensure that the presence of explosive gases is below dangerous concentration levels (less than 25 percent by volume).

Perform above environmental tests each time work is started or at the initial crew change and repeat in a time interval not to exceed 8 hours. If prolonged forced ventilation is required, the time interval for additional tests must not exceed 2 hours.

Two persons must be present during manhole operations: one man enters the manhole, the other must remain outside. Outside man must be equipped with a communication device to call for help if necessary.

If environmental tests indicate atmosphere is not safe, use blowers or ejectors to clear all manholes or cable vaults of vapors, fumes, and gases to a safe level.

Operate blowers continuously while work is being performed and until work is completed.

Blowers must not be placed in the manhole or cable vault but must be located on the surface at a distance not less than 1500 millimeter 5 feet from the open manhole or cable vault to assure a safe operating atmosphere. Engine driven equipment must be located downwind from manholes and must have ducted exhausts away from manhole opening.

Use ladders of the proper length and type (wood or fiberglass) for entry into manholes.

Locate all engine driven equipment downwind from manholes.

3.3 UNDERGROUND CONDUIT

The [4] [_____] duct or conduit assignment for individual cables must be as indicated. Cables must not be placed in ducts or conduits other than those indicated.

Assigned duct must be rodded, cleaned, and tested for alignment as specified in TO 31W3-10-12. Mechanical equipment with which lines must be used at both ends of the section to be rodded which must work the line back and forth through the ducts. The KSC duct system does not contain pulling lines and can contain orangeburg material. Some sections could require mechanical rodding equipment with cutting tools and water pressure equipment to clean and align the defective or blocked orangeburg duct as necessary.

3.4 CABLE PLACEMENT

Exercise adequate care when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions must not be installed.

3.4.1 Securing Cable

Immediately after cable placement, temporary tags with the cable number and pair count must be attached to each end of each cable section.

Support and secure cables and equipment. Where the specific method of support is not shown, use adequate supports and fasteners to secure cables and equipment in position. Metallic supports and fasteners must have a corrosion-resistant finish. All cables and equipment installed in exterior locations must be secured so that they cannot be dislodged or damaged by winds up to 200 kilometer 125 miles per hour.

House cable splices in a splice case installed along the cable route, mounted in the duct system cable vaults and manholes. Splice case must provide a protected environment for the splices and must maintain the moisture barrier properties of the cable. Cable splices in duct or conduit sections are prohibited.

3.4.2 Bending

Use caution when bending cable to avoid kinks or other damage to the sheath. Bend radius must be as large as possible with a minimum of not less than 10 times the O.D. of the cable. Increase minimum radii when necessary to meet cable manufacturer's recommendations. Perform bending operations in manholes and vaults in accordance with the procedures and instructions of the manufacturer. Use cable bending shoes at duct or conduit ends when bending cable exiting a duct or conduit. Bending shoes must remain in place until racking, splicing, and tying is completed. Cables must not rest against the edge of the duct or conduit mouth.

Number of unspliced cable ends in a manhole, vault, or terminal room must not exceed eight ends in manholes or four ends in vaults or terminal rooms. When a larger number of cables is to be placed, the cables must be pulled, racked, and spliced or terminated in an order that does not exceed the above limitation. End slack in excess of that needed to properly rack and splice or terminate the cables must not be pulled in manholes or vaults. End slack must provide 1200 to 1500 millimeter 4 to 5 feet of overlap for splicing.

3.4.3 Pulling

When a duct or conduit has an appreciable curve, and conditions permit, set up the cable reel at the end nearest the bend and pull the cable from the opposite end. Otherwise, pull the cable from the most convenient end.

Attach pulling lines to cable ends fitted with factory-installed pulling eyes. Cables not equipped with a pulling eye must have the pulling line attached to the cable end by means of a cable grip. Core hitches must not be used.

Set up rigging at the pulling end so that the pulling line and cable enter or exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Cable ends must not be pulled around sheave wheels. When the end slack for proper racking and splicing with the pulling line attached to the end of the cable, a split cable grip can be used to obtain the necessary slack.

3.4.4 Set Up

Locate and align cable reels so that the cable is paid off the top of the reel into the duct or conduit in a long, smooth bend without twisting. Cable must not be pulled from the bottom of a reel or subjected to reverse bends from those formed by factory reeling. Use a cable feeder guide of proper size at the mouth entrance. Lay unterminated cables in the specified routing and location as indicated. Clear, cap and seal unterminated cable ends. Lubricant must be compatible with, and intended for use with, Stalpeth sheathed cables. Soap and grease lubricants are prohibited.

Carefully check all equipment and the pulling setup to minimize interruptions once pulling begins. Insofar as possible, pull the cable without stopping until the required amount of cable has been placed. If for any reason the pulling operation must be halted before the pull is complete, the tension of the pulling line must not be released. When pulling is resumed, overcome the inertia of the cable by increasing the tension in small steps a few seconds apart until the cable is in motion. Cable must be paid off the reel by rotating the reel in the feed direction and not stripped off the reel by pulling.

3.4.5 Damage

Carefully inspect cable for sheath defects or other irregularities as it is paid off the reel. If defects are detected, pulling must stop immediately and the cable section must be repaired or replaced at the discretion of the Contracting Officer. Maintain a system of communications, visual or otherwise, between feed and pulling locations so that pulling can be stopped instantly, if necessary.

"Pull-throughs" (continuous cable through two or more duct sections without splicing in an intermediate manhole) require the approval of the Contracting Officer. Use appropriate size split grip, manhole sheaves, sheave shackles and increased lubricant as well as exercising caution during the pulling operation to avoid excess slack and prevent kinking or any damage to the cable. Cables in the intermediate manhole must be suitably racked at the time of installation with no sheath defects or other irregularities.

Cable ends pulled into manholes or vaults that are not to be racked or otherwise permanently positioned, must immediately be tied in fixed positions with ties to prevent damage to the cables and to provide adequate working space. After final racking and splicing, plastic sheathed cables in manholes and vaults must be secured in place with lashed cable supports. When securing cables and details are not indicated, secure the cables in a manner that maintains the cables in the required position without damage to the cables.

3.5 CABLE SPLICING

Splice cables in accordance with the manufacturer's approved procedures.

Conductors must remain in their correct color groups or unit.

Install unterminated cables as indicated. Unterminated or dead cable pairs must be connected through to other unterminated or dead cable pairs, cleared at each end and tested according to other portions of this specification.

3.6 BONDING AND GROUNDING SYSTEMS

Cables must be grounded. Overall shield of all cables installed must be grounded at each terminal point or bonded across all splice points and to a manhole bonding ribbon.

3.7 CABLE TERMINATIONS

Terminate cables as shown on contract drawings. Installation must not impede future installations and must not damage existing.

3.8 TESTING AUDIO CABLES

Electrical acceptance testing for cables under this specification must be in accordance with TO 31W3-10-15. Field tests must be witnessed by the Government. Give five working days notice prior to performing each test. Measured electrical parameter must conform to the manufacture stated specification. Sample forms included at the end of this section can be used. Include test forms and procedures in the test plan. Correct all test anomalies.

3.8.1 Test Equipment

Test equipment must be of sufficient accuracy, quality, and quantity to perform specified tests.

Perform insulation resistance tests with a 500-volt insulation resistance test set.

Use of auxiliary test boards, panels, or other special equipment to facilitate the testing procedure is optional, subject to approval. Equipment must not cause any appreciable change in the actual cable measurements being made and must be designed to permit ready verification of the internal circuits and components.

All test equipment must be calibrated by a certified testing company every 80 days unless required sooner because of damage or inaccuracy. Standards for calibrating must be as listed by the National Bureau of Standards, and each item of test equipment must display a current calibration sticker.

3.8.2 Section Tests

Make end-to-end tests for shorts, crosses, opens, grounds, splits and transpositions and record each conductor condition separately.

3.8.3 Loop Resistance Tests

Make and record loop resistance tests of each pair.

3.8.4 Insulation Resistance Tests

Make and record end-to-end test of each conductor to all other conductors and all conductors to ground (shield).

3.9 OPERATION AND MAINTENANCE

Submit [6] [_____] copies of the Operation and Maintenance Manuals for the following items. Update and resubmit data for final approval no later than 30 days prior to contract completion.

Operation and maintenance manuals must be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must have 9.5 millimeter 3/8-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Clearly label caution and warning indications.

Provide classroom and field instructions in operation and maintenance of systems equipment where required by the technical provisions. Direct these services, using the manufacturer's factory-trained personnel or qualified representatives. Give Contracting Officer 7 days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor (e.g., lists, static exhibits, visual aids) must be made available to the Contracting Officer.

-- End of Section --